CLAIMS

1. A method of controlling an alternating current motor and a power converter including:

a converter unit for converting an alternating current voltage supplied from an alternating current power supply into a direct current voltage, and

a smoothing capacitor for smoothing the converted direct current voltage, and

an inverter unit for converting a direct current intermediate voltage into an alternating current voltage having a frequency corresponding to a torque instruction by a PWM control manner,

by setting an electromotive torque limit value and a regenerative torque limit value in advance, and by restricting the torque instruction with the torque limit values to generate a PWM switching pattern to be output to the inverter unit,

the method comprising the steps of:

allowing a power failure detecting unit provided in the power converter to detect a power failure of the alternating current power source;

outputting a deceleration start instruction to the inverter unit in response to a power failure detecting signal output from the power failure detecting unit;

calculating a first reduction rate, on the basis of a detection value and a target value of the direct current intermediate voltage, such that the direct current intermediate voltage is made constant during the deceleration of the alternating current motor;

calculating a second reduction rate on the basis of a variation in the direct current intermediate voltage;

controlling a deceleration time by controlling a value obtained by multiplying the two reduction rates together in a PI control manner;

calculating the torque instruction to allow the alternating current motor to be decelerated for the deceleration time;

changing the electromotive torque limit value and the regenerative torque limit value on the basis of the value of the detected direct current intermediate voltage;

stopping the deceleration when the direct current intermediate voltage is equal to a voltage before the power failure is detected or it rises during the deceleration; and

when the alternating current motor is returned to a normal control mode, storing an output frequency before the power failure is detected.

2. The method of controlling an alternating current motor according to claim 1, wherein

when the direct current intermediate voltage is equal to the voltage before the power failure is detected or it rises during the deceleration, the deceleration stops, and

when the alternating current motor is returned to the normal control mode, the alternating motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

3. The method of controlling an alternating current motor according to claim 1, wherein

when the direct current intermediate voltage is equal to the voltage before the power failure is detected or it rises during the deceleration, the deceleration stops, and

when the alternating current motor is returned to the normal control mode, a torque limit unit restricts the torque instruction with an arbitrary electromotive torque limit value until the output frequency of the alternating current motor is equal to the output frequency stored before the power failure is detected.

4. A control device which controls an alternating current motor and a power converter including:

a converter unit for converting an alternating current voltage supplied from an alternating current power supply into a direct current voltage,

a smoothing capacitor for smoothing the converted direct current voltage, and

an inverter unit for converting a direct current intermediate voltage into an alternating current voltage having a frequency corresponding to a torque instruction by a PWM control manner,

by setting an electromotive torque limit value and a regenerative torque limit value in advance, and by restricting the torque instruction with the torque limit values to generate a PWM switching pattern to be output to the inverter unit,

the control device comprising:

a power failure detecting unit which detects a power failure of the alternating current power source;

a unit which outputs a deceleration start instruction to the inverter unit in response to a power failure detecting signal output from the power failure detecting unit, calculates a first reduction rate, on the basis of a detection value and a target value of the direct current intermediate voltage, such that the direct current intermediate voltage is made constant during the deceleration of the alternating current motor, and

calculates a second reduction rate on the basis of a variation in the direct current intermediate voltage;

a unit which controls a deceleration time by controlling a value obtained by multiplying the two reduction rates together in a PI control manner;

a unit which calculates the torque instruction to allow the alternating current motor to be decelerated for the deceleration time and changes the electromotive torque limit value and the regenerative torque limit value on the basis of the value of the detected direct current intermediate voltage;

a unit which stops the deceleration when the direct current intermediate voltage is equal to a voltage before the power failure is detected or it rises during the deceleration; and

a unit which stores an output frequency before the power failure is detected when the alternating current motor is returned to a normal control mode.

5. The control device for an alternating current motor according to claim 4, wherein

when the direct current intermediate voltage is equal to the voltage before the power failure is detected or it rises during the deceleration, the deceleration stops, and

when the alternating current motor is returned to the

normal control mode, the alternating motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

6. The control device for an alternating current motor according to claim 4, wherein

when the direct current intermediate voltage is equal to the voltage before the power failure is detected or it rises during the deceleration, the deceleration stops, and

when the alternating current motor is returned to the normal control mode, the torque limit unit restricts the torque instruction with an arbitrary electromotive torque limit value until the output frequency of the alternating current motor is equal to the output frequency stored before the power failure is detected.

7. A method of controlling an alternating current motor and a power converter including:

a converter unit for converting an alternating current voltage supplied from an alternating current power supply into a direct current voltage,

a smoothing capacitor for smoothing the converted direct current voltage, and

an inverter unit for converting a direct current

intermediate voltage into an alternating current voltage having a frequency corresponding to a torque instruction by a PWM control manner,

the method comprising the steps of:

setting an electromotive torque limit value and a regenerative torque limit value in advance;

restricting the torque instruction with the torque limit values to generate a PWM switching pattern to be output to the inverter unit;

setting a lower limit voltage V_{U1} of the direct current intermediate voltage required for a normal driving mode, a lower allowable voltage V_{U0} of the direct current intermediate voltage when a lowest voltage of a power supply is input, and a power failure detecting level voltage V_{U2} which is lower than the lower allowable voltage V_{U0} and is higher than the lower limit voltage V_{U1};

when a detection value of the direct current intermediate voltage output from a direct current intermediate voltage detecting circuit is lower than the power failure detecting level voltage V_{U2} during the driving of the alternating current motor, decelerating the alternating current motor at a reduction rate α_d until the direct current intermediate voltage is higher than the lower allowable voltage V_{U0};

when the direct current intermediate voltage is

higher than the lower allowable voltage V_{U0}, returning the alternating current motor to a normal control mode; and

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, storing an output frequency before the power failure is detected.

8. The method of controlling an alternating current motor according to claim 7, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

9. The method of controlling an alternating current motor according to claim 7, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, a torque limit unit restricts the torque instruction with an arbitrary electromotive torque limit

value until the output frequency of the alternating current motor is equal to the output frequency stored before the power failure is detected.

10. A control device which controls an alternating current motor and a power converter including:

a converter unit for converting an alternating current voltage supplied from an alternating current power supply into a direct current voltage,

a smoothing capacitor for smoothing the converted direct current voltage, and

an inverter unit for converting a direct current intermediate voltage into an alternating current voltage having a frequency corresponding to a torque instruction by a PWM control manner,

the control device controlling the alternating current motor in the following sequence of:

setting an electromotive torque limit value and a regenerative torque limit value in advance;

restricting the torque instruction with the torque limit values to generate a PWM switching pattern to be output to the inverter unit;

setting a lower limit voltage V_{U1} of the direct current intermediate voltage required for a normal driving mode, a lower allowable voltage V_{U0} of the direct current

intermediate voltage when a lowest voltage of a power supply is input, and a power failure detecting level voltage V_{U2} which is lower than the lower allowable voltage V_{U0} and is higher than the lower limit voltage V_{U1};

when a detection value of the direct current intermediate voltage output from a direct current intermediate voltage detecting circuit is lower than the power failure detecting level voltage V_{U2} during the driving of the alternating current motor, decelerating the alternating current motor at a reduction rate α_d until the direct current intermediate voltage is higher than the lower allowable voltage V_{U0};

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0}, returning the alternating current motor to a normal control mode; and

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, storing an output frequency before the power failure is detected.

11. The control device for an alternating current motor according to claim 10, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the

alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

12. The control device for an alternating current motor according to claim 10, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, a torque limit unit restricts the torque instruction with an arbitrary electromotive torque limit value until the output frequency of the alternating current motor is equal to the output frequency stored before the power failure is detected.

13. A method of controlling an alternating current motor, comprising the steps of:

providing a power failure detecting unit for detecting a power failure of the alternating current motor in a power converter;

outputting a deceleration start instruction to an inverter unit in response to a power failure detecting signal output from the power failure detecting unit;

calculating a first reduction rate, on the basis of a detection value and a target value of a direct current intermediate voltage, such that a direct current intermediate voltage is made constant during the deceleration of the alternating current motor;

calculating a second reduction rate on the basis of a variation in the direct current intermediate voltage;

controlling a deceleration time by controlling a value obtained by multiplying the two reduction rates together in a PI control manner;

when the direct current intermediate voltage is equal to a voltage before the power failure is detected or it rises during the deceleration, stopping the deceleration and returning the alternating current motor to a normal control mode; and

when the direct current intermediate voltage is equal to the voltage before the power failure is detected or it rises during the deceleration to cause the deceleration to stop and the alternating current motor to be returned to the normal control mode, storing an output frequency before the power failure is detected.

14. The method of controlling an alternating current motor according to claim 13, wherein

when the direct current intermediate voltage is equal

to the voltage before the power failure is detected or it rises during the deceleration to cause the deceleration to stop and the alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

15. A control device which controls an alternating current motor, comprising:

a power converter; and

a power failure detecting unit which detects a power failure of the alternating current motor and is provided in the power converter, wherein

a deceleration start instruction is output to an inverter unit in response to a power failure detecting signal output from the power failure detecting unit,

a first reduction rate is calculated, on the basis of a detection value and a target value of a direct current intermediate voltage, such that a direct current intermediate voltage is made constant during the deceleration of the alternating current motor,

a second reduction rate is calculated on the basis of a variation in the direct current intermediate voltage,

a value obtained by multiplying the two reduction

rates together is controlled in a PI control manner to control a deceleration time,

when the direct current intermediate voltage is equal to a voltage before the power failure is detected or it rises during the deceleration, a torque instruction is calculated to allow deceleration to stop and the alternating current motor to be decelerated for the deceleration time, and returning the alternating current motor to a normal control mode,

an electromotive torque limit value and a regenerative torque limit value are changed on the basis of the value of the detected direct current intermediate voltage,

a torque limit unit restricts the torque instruction, and

when the direct current intermediate voltage is equal to a voltage before the power failure is detected or it rises during the deceleration to cause the deceleration to stop and the alternating current motor to be returned to the normal control mode, an output frequency before the power failure is detected is stored.

16. The method of controlling an alternating current motor according to claim 15, wherein

when the direct current intermediate voltage is equal

to the voltage before the power failure is detected or it rises during the deceleration to cause the deceleration to stop and the alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

17. A method of controlling an alternating current motor, comprising the steps of:

setting a lower limit voltage V_{U1} of a direct current intermediate voltage required for a normal driving mode, a lower allowable voltage V_{U0} of the direct current intermediate voltage when a lowest voltage of a power supply is input, and a power failure detecting level voltage V_{U2} which is lower than the lower allowable voltage V_{U0} and is higher than the lower limit voltage V_{U1};

when a detection value of the direct current intermediate voltage output from a direct current intermediate voltage detecting circuit is lower than the power failure detecting level voltage V_{U2} during the driving of the alternating current motor, decelerating the alternating current motor at a reduction rate α_d until the direct current intermediate voltage is higher than the lower allowable voltage V_{U0};

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0}, returning the alternating current motor to a normal control mode; and

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, storing an output frequency before the power failure is detected.

18. The method of controlling an alternating current motor according to claim 17, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.

19. A control device for an alternating current motor, comprising:

a sequence unit which performs the functions of:

setting a lower limit voltage V_{U1} of a direct current intermediate voltage required for a normal driving mode, a lower allowable voltage V_{U0} of the direct current

intermediate voltage when a lowest voltage of a power supply is input, and a power failure detecting level voltage V_{U2} which is lower than the lower allowable voltage V_{U0} and is higher than the lower limit voltage V_{U1};

when a detection value of the direct current intermediate voltage output from a direct current intermediate voltage detecting circuit is lower than the power failure detecting level voltage V_{U2} during the driving of the alternating current motor, decelerating the alternating current motor at a reduction rate α_d until the direct current intermediate voltage is higher than the lower allowable voltage V_{U0}; and

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0}, returning the alternating current motor to a normal control mode,

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the alternating current motor to be returned to the normal control mode, storing an output frequency before the power failure is detected.

20. The control device for an alternating current motor according to claim 19, wherein

when the direct current intermediate voltage is higher than the lower allowable voltage V_{U0} to cause the

alternating current motor to be returned to the normal control mode, the alternating current motor is accelerated for an arbitrary acceleration time until its output frequency is equal to the output frequency stored before the power failure is detected.